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Work in Progress: Engineering First-Year Academy to Help Underprepared Students

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Introduction

This work-in-progress paper describes an effort to improve the retention rate of traditional first-year students in the School of Computing and Engineering (SCE) at Quinnipiac University through the implementation of First-Year Academy (FA). Quinnipiac University, a private institution in northeastern United States, is a comprehensive university with nine academic units, including SCE. Retention rate of SCE first-year students lags the national retention rate of engineering programs. The goal of SCE is to have a retention rate that is on-par with the national average rate of 80% for persistence to sophomore year [1] in three years and to surpass it by five percentage points, at 85%, in the fourth year.

Through institution-specific data, students in SCE tend to leave after their first year primarly because of struggles with the transition from high school to college, feeling overwhelmed by the amount of work in their courses, or because they lack a sense of belonging within the community. FA is created to address these issues and to increase SCE's retention rate. FA aims to develop a significant support structure to improve the success rate of students and help them thrive. As a result, SCE will improve its first-to-sophomore year retention rate. Currently, the first-to-second year retention rate of SCE first-year students is at 62.07%; this rate is at 94% through sophomore year. The focus on first-year students is aligned with other studies on retention efforts, which focus on first-year students [2]. In addition, an engineering education requires certain academic components not found in other studies. Therefore, it is important to understand the retention issues directly related to SCE rather than that of the whole university [3].

Certain academic and personality criteria are used to select a subset of the incoming traditional first-year students as suitable candidates for FA. Some of the criteria are academic, namely math placement test score and SAT Math score. Others are personality-based, using relevant scales from the Ruffalo Noel Levitz *College Student Inventory (CSI),* most important of which is "predicted academic difficulty". The CSI is a survey that helps identify first-year students who may struggle academically or leave SCE [4].

FA's focus is on students who are underprepared, and not diversity per se. However, the analyses of students' demographic characteristics over the past three academic years reveal that students who are underprepared tend to be female and from underrepresented minority backgrounds. Table 1 outlines the differences in retention between these groups. Female students who leave SCE tend to do so even with higher SAT Math and math placement test scores, indicating they are academically capable of remaining in the program but still decide to leave. Additionally, students who identify as underrepresented minorities tend to achieve lower SAT Math and math placement test scores, which may influence a decision to leave SCE. The connection FA has to diversity in the talent pipeline prompted a corporate partnership with a large manufacturing company to fund the program. It should be noted that students incur no additional costs by being in FA.

Table 1. SAT Math and math placement test scores of incoming students

	SAT Math		**Math Placement Test Score**	
	Retained	Lost	Retained	Lost
Male	614.84	580.00	4.32	3.69
Female	601.48	585.88	4.23	3.93
White	623.78	592.44	4.41	4.02
Black	540.00	532.50	3.47	3.25
Hispanic	569.09	516.67	3.94	3.09

The three main pillars of FA are to enhance students' academic performance, to help with their transition to college, and to promote their sense of belonging through creating a community.

Academically, FA provides Study Table and one-on-one tutoring opportunities. An upper-class student takes on the duties of a Peer Mentor (PM) and runs the Study Table sessions. In a typical Study Table session, student participants work amongst their peers to do any schoolwork without distractions. The Study Table session occurs at a designated time for one hour each week in the SCE building on campus. Additional upper-class students take on peer tutoring duties for cource-specific questions. All FA students are expected to attend every Study Table during the semester because of the academic and mentoring benefits. Mentoring within scientific fields can have a significant impact on student performance with the use of instrumental and socioemotional mentoring techniques. These mentoring practices provide resources to foster academic success and motivational support [5]. Another source of academic support for FA students is provided by the FA Faculty Advisor. Students have a bi-weekly check-in session with the facuty advisor to provide a status and to seek advice on challenges faced.

FA students' transition to college is supported by an Academic Coach, a university staff member whose role is to work with students on study habits and techniques, thereby ensuring their success. In addition to forming a relationship with the Academic Coach, the students also form a relationship with the PM, a current upper-class student in SCE. The PM works with the students to answer their general questions and to alleviate their anxieties related to transitioning into a new environment.

Outside of formal academics, FA supports social and relationship-building aspects of first-year integration through regularly held social events. During Summer II, the PM runs weekly social events virtually. In the week prior to the start of the fall term, an in-person social excursion takes place, with a focus on team-building. Furthermore, students are assigned to cohorts so that they know at least one other FA student in each of their courses. A main purpose of the social and relationship-building components of FA is to build a sense of belonging. This is especially important for women as confidence and a sense of belonging are more important predictors of withdrawal from SCE than academic reasons. This is in line with another study [6] that found female students tend to leave engineering majors with GPAs higher than those of the male students in the same programs.

Experimental Methods / Project Approach

Students in FA begin their college experience in the Summer II term, a condensed 7-week term, from early July to late August. The students take a Learning Strategies Seminar and Introduction to Programming. Learning Strategies Seminar is a 0-credit metacognition course focused on study habits and techniques, resilience, and a growth mindset. This course is taught by the Academic Coach so that students can begin forming a relationship with their Academic Coach before they even start the fall term. University-wide data from the last two years shows that students who actively engage with the Academic Coach and subsequently take advantage of educational resources have a higher GPA than those who do not. For the Fall 2019 cohort, students who did not utilize their Academic Coach or Learning Commons resources during the academic year maintained an average GPA of 2.56 compared to 3.02 of those who did.

The other course in Summer II is Introduction to Programming, a required 3-credit course in SCE, to lighten the fall course load. With 3 credits completed in the summer, students only take 12 or 13 credits during the fall semester, instead of the full load of 16 credits that other first-year students take. Students' experience a more seamless transition to the academic year as a result of taking a required course over the summer, thereby reducing their academic load in the fall, and learning metacognitive strategies that are relevant for all their college courses [7].

In addition to the Summer II courses, students participate in Study Tables and virtual social events led by the PM. Two Study Tables are held each week during Summer II with the PM and Peer Tutors (PT) to provide students with academic support. These Study Tables provide students with the opportunity to ask any questions they have about entering college or their current coursework. Virtual social events help create the foundation for a supportive peer community. At these events, students interact with each other and begin building friendships.

The Faculty Advisor ensures that FA students are cohorted in their math, English, and Introduction to Engineering courses to foster a community of peer support. Throughout the fall semester, students continue meeting with the PM and PTs at weekly Study Tables. During the Study Tables, the PM makes sure the students use the hour strictly on academic work, with no distractions. The students are free to work with others or on their own to complete assignments in any of their courses. The PTs mainly help with math and computer science courses.

In-person social events continue during the fall semester once a month. The events are suggested and chosen by the FA students. In addition to providing a fun element, these social events help to build a sense of community. The Faculty Advisor also continues supporting students through biweekly check-in meetings. During these meetings, the advisor checks how students are progressing in each of their courses, how they are fitting in, and whether there are any concerns to be addressed.

Results and Discussion

Grade Analysis

We conducted an analysis to determine whether FA students had performed better than their peers in overall term GPA, as well as their final grade in their math course. Since [8] identifies GPA as the most important predictor of engineering retention, our analysis includes the fall GPA of students after their first semester. The FA students were divided into two groups depending on their original math placement scores: those who placed into College Algebra (a placement score of 2 out of 5) and those who placed into Pre-Calculus (scores of 3 and 4). This division of students based on their placement scores was maintained when comparisons were made with their non-FA peers. In other words, the FA students in College Algrebra were compared only with their peers who also placed into College Algebra. Of the nine FA students, two took College Algebra in the fall and seven took Pre-Calculus. None of the FA students had a score of 5, which would have placed them into Calculus I. Due to the small sample size in each group, many of our findings are observations rather than statistical conclusions.

Of the seven students with math placement scores of 2, the two FA students tended to have higher GPAs than their peers (2.7850, n=2 vs 2.2460, n=5), but the higher GPAs may be due to chance (p = .647) (figure 1a).

The overall GPA of the seven FA students with math placement test scores of 3 or 4 were higher than those of their peers, and the difference was not due to chance (3.0012 vs. 2.2209, t(40)=1.453, p = .011) (figure 1b).

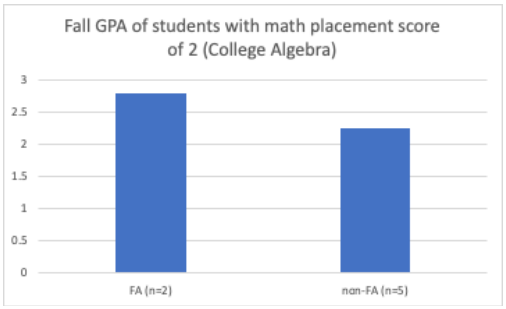

Figure 1a

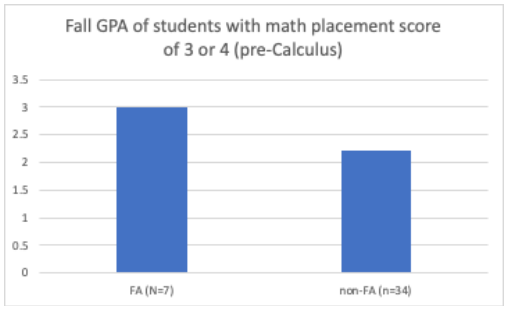

Figure 1b

Figure 1: Comparison of fall GPA of First-year Academy students and their peers placed in (a) college algebra and (b) pre-calculus

Two other markers that should be noted are the number of course withdrawals and F grades. The FA students did not withdraw from any courses in the fall semester. In addition, there was a single F grade in the collective courses of the nine students. These two markers can be compared to the performance of non-FA first-year SCE students with math placement test scores of 2, 3, or 4. There were 11 W's and 22 F's among the peers (figures 2a and 2b).

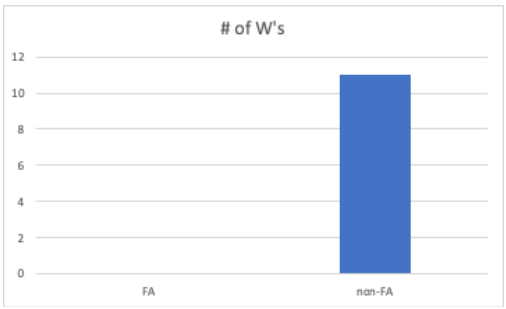

Figure 2a

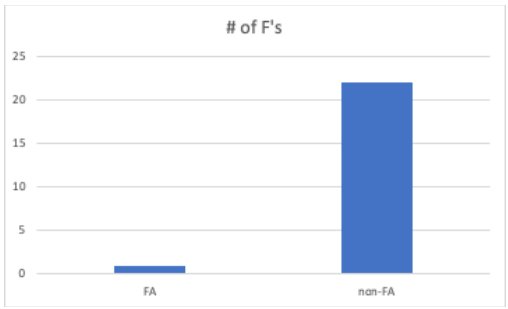

Figure 2b

Figure 2: Comparison of course (a) withdrawals and (b) failed grades of First-year Academy students and their peers

Wellbeing

As an integral part of the evaluation of the new residence experience curriculum, a survey was developed by the Office of Academic Innovation & Effectiveness, which was administered to students one-by-one by their Resident Assistants. The intent was to determine whether students were thriving on campus and forming important connections with their faculty, staff, and peers. The FA students had similar levels of wellbeing as their peers: FA students (M=1.89, SD = .333) vs. Peers (M=1.98, SD = .141) t(1489) = -1.906, p = .437.

Learning and Development

Metacognitive Awareness-Learning and Development Inventory

The Office of Academic Innovation & Effectiveness administers the Metacognitive Awareness-Learning and Development Inventory (the "FYS Survey") to all first-year students in their mandatory First-Year Seminar sections. The scores of the FA students were compared to those of their peers. In the first analysis, the scores of the FA students were compared to only those in SCE. The only difference that was not due to chance was on the scale dealing with confidence in math and quantitative literacy. The FA students tended to have lower scores (2.750 vs. 3.7042, p = .005). In the second analysis, the scores of FA students were compared to all students in the incoming class. Statistically significant differences were not observed. This finding indicates that the students in SCE were more confident in math and quantitative literacy than their peers throughout the university, and the FA students were more similar in this regard to their peers in the incoming class than to their peers in SCE.

This finding is not surprising, and a notable observation is that the students in the FA tended not to differ from their peers on such metrics of learning and development as sense of belonging, coping with hesitancy to approach professors and performance anxiety, academic engagement, and connectedness with faculty and peers.

Fall Study Table Growth

At the Study Tables in the fall semester, the PM and PTs observed how students developed their peer community and improved their study techniques. These qualitative observations by the PM and the PTs were captured at the fall debrief session. With the in-person setting in the fall, students were more willing to interact with each other to ask about due dates and assignment

details. Along with the academic benefits, the Study Tables also encouraged peer socialization and helped to foster friendships. At the end of the fall semester, when the students were asked to rate the usefulness of the Study Table sessions, the average rating was 8.6 out of 10, with a score of 10 indicating a high level of perceived usefulness.

Follow-up College Student Inventory Survey

Students' scores on a CSI follow-up survey after one semester were consistent with their scores at orientation. An important indicator of change was the decrease in students feeling that they needed to receive help in improving study skills (6.13 vs. 4.38, p = .041). Their scores on this item were correlated with scores on items dealing with concentrating on schoolwork (r = .893, p = .003), receiving individual help in improving math skills (r=.737, p = .037), and receiving help in reading skills (r=.859, p = .006). Improvement was observed in students' evaluation of their capability to write a very clear and well-organized paper (4.00 vs. 5.13, p = .015). These are early indicators of students' enhanced academic habits of mind. If the trend continues, then it is expected that the students will have higher scores on metrics of academic habits of mind and achievement after entering into their second year of college (figure 3).

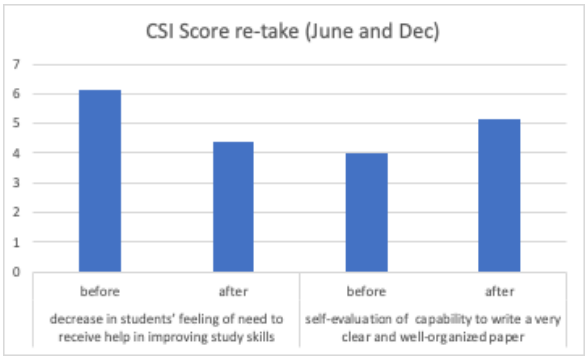

Figure 3: Improvement of FA students' academic habits of mind and achievement

Registered for Spring 2022

The students in the FA had higher retention rates than their SCE peers with math placement test scores of 2, 3, and 4. All nine FA students were retained, whereas 38 out of 42 non-FA students were retained (figure 4). When comparing the FA students to the entire SCE first-year traditional students, the retention rate is still higher, but the difference may be due to chance. FA (M=2, SD = 0) vs. SCE Peers (M=1.94, SD = .237), t(92) = .742, p = .460), where retention is coded as follows: 1 = withdrew, 2 = retained.

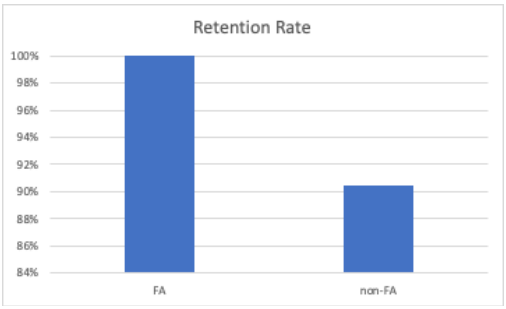

Figure 4: 2021 Fall retention rate of FA students compared to their peers

Future Work

Spring Semester

In a survey completed by the students at the end of the fall semester, the students described the sense of support they felt from the PM, PTs, Faculty Advisor, and Academic Coach. The survey provided students with an opportunity to rate the sense of support from 1 to 10, where 1 represents the weakest and 10 represents the strongest. Based on the responses received, students felt a strong sense of support from the PM and Faculty Advisor, with an average rating of 9.4. The PTs received an average rating of 8.8, and the Academic Coach received an average rating of 8.6. Due to these positive survey results, FA students will continue to interact with the people who provide these support resources in the future.

During the spring semester, Study Tables continued to be held on a weekly basis with the PM and PTs available as resources. The social events in the Spring semester occurred less frequently to encourage students to socialize outside of the FA program with other students in SCE and the university. Furthermore, the Faculty Advisor continued bi-weekly check-ins to ensure that students felt comfortable and supported throughout their entire first year. FA students continued to interact with the Academic Coach at Study Tables and periodic one-on-one sessions. During the spring semester, FA students took a full load of credits because this course load is typical of what they will encounter throughout the rest of their time in SCE.

Beyond 2021-22 Academic Year

In the inaugural FA year, there was a small group of 9 students who participated. Although the target number for the inaugural year was 20 students, the program did not receive funding until late June. This took away the ability to advertise and recruit during orientation events. Many of the invited students did not check their emails; others did not want to commit to a program with a major summer component when it was already so late in the summer. The plan is to increase thie number of particpants to 20 next year, and 30 the year after. The goal is to have 40 students in the program by the academic year of 2024–2025. We plan to keep it at or below 40 students to maintain a tight-knit community and hopefully integrate it successfully with the Engineering Living Learning Community.

In the upcoming academic year, the PM will begin a group chat in the summer term to facilitate peer interactions from the beginning. The PM and PTs observed that students often deferred questions to the upperclassmen students, rather than their peers who were in the same classes. With a group chat including the PM, students can ask questions to one another, and the PM can contribute to the conversation when necessary. Encouraging FA students to interact with each other at the onset of the program will help build a strong foundation for the community that may carry forward for the next four years. An addition to the spring semester will be the reintroduction of Learning Strategies Seminar for FA students with a Fall GPA < 2.8. Although the FA students take Learning Strategies Seminar during the summer term, repeating the course in the spring can remind students of important concepts. After one full semester as college students, reinforcement of helpful study techniques, learning strategies, and metacognition skills can facilitate further academic improvement among the students.

References

[1] B. Yoder, “Engineering by the numbers: ASEE retention and time-to-graduation benchmarks for undergraduate engineering schools, departments and programs,” 2016.

[2] N. B. Honken and P. Ralston, “Freshman engineering retention: A holistic look,” vol. 14, no. 2, 2013.

[3] C. P. Veenstra, E. L. Dey, and G. D. Herrin, “A Model for Freshman Engineering Retention.,” vol. 1, no. 3, p. n3, 2009.

[4] W. D. Slanger, E. A. Berg, P. S. Fisk, and M. G. Hanson, “A longitudinal cohort study of student motivational factors related to academic success and retention using the college student inventory,” vol. 17, no. 3, pp. 278–302, 2015.

[5] R. D. Robnett, P. A. Nelson, E. L. Zurbriggen, F. J. Crosby, and M. M. Chemers, “Research mentoring and scientist identity: insights from undergraduates and their mentors,” vol. 5, no. 1, pp. 1–14, 2018.

[6] M. J. Borrego, M. A. Padilla, G. Zhang, M. W. Ohland, and T. J. Anderson, “Graduation rates, grade-point average, and changes of major of female and minority students entering engineering,” 2005, pp. T3D-1.

[7] A. Young and J. D. Fry, “Metacognitive awareness and academic achievement in college students.,” vol. 8, no. 2, pp. 1–10, 2008.

[8] G. Mendez, T. D. Buskirk, S. Lohr, and S. Haag, “Factors associated with persistence in science and engineering majors: An exploratory study using classification trees and random forests,” vol. 97, no. 1, pp. 57–70, 2008.